

Permit Number 20874(01)
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September 2, 2004
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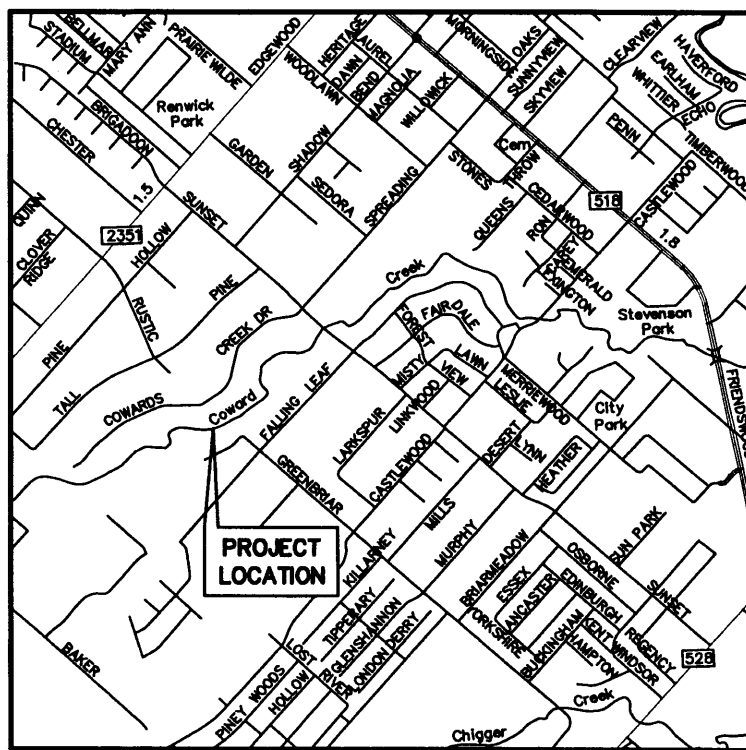


FIGURE "1"
VICINITY MAP

SCALE: 1" = 1/2 MI.
KEY MAP: 656-G



SWCA
ENVIRONMENTAL CONSULTANTS

Coward Creek Project
Proposed Activity - Vicinity Map
Galveston County, TX

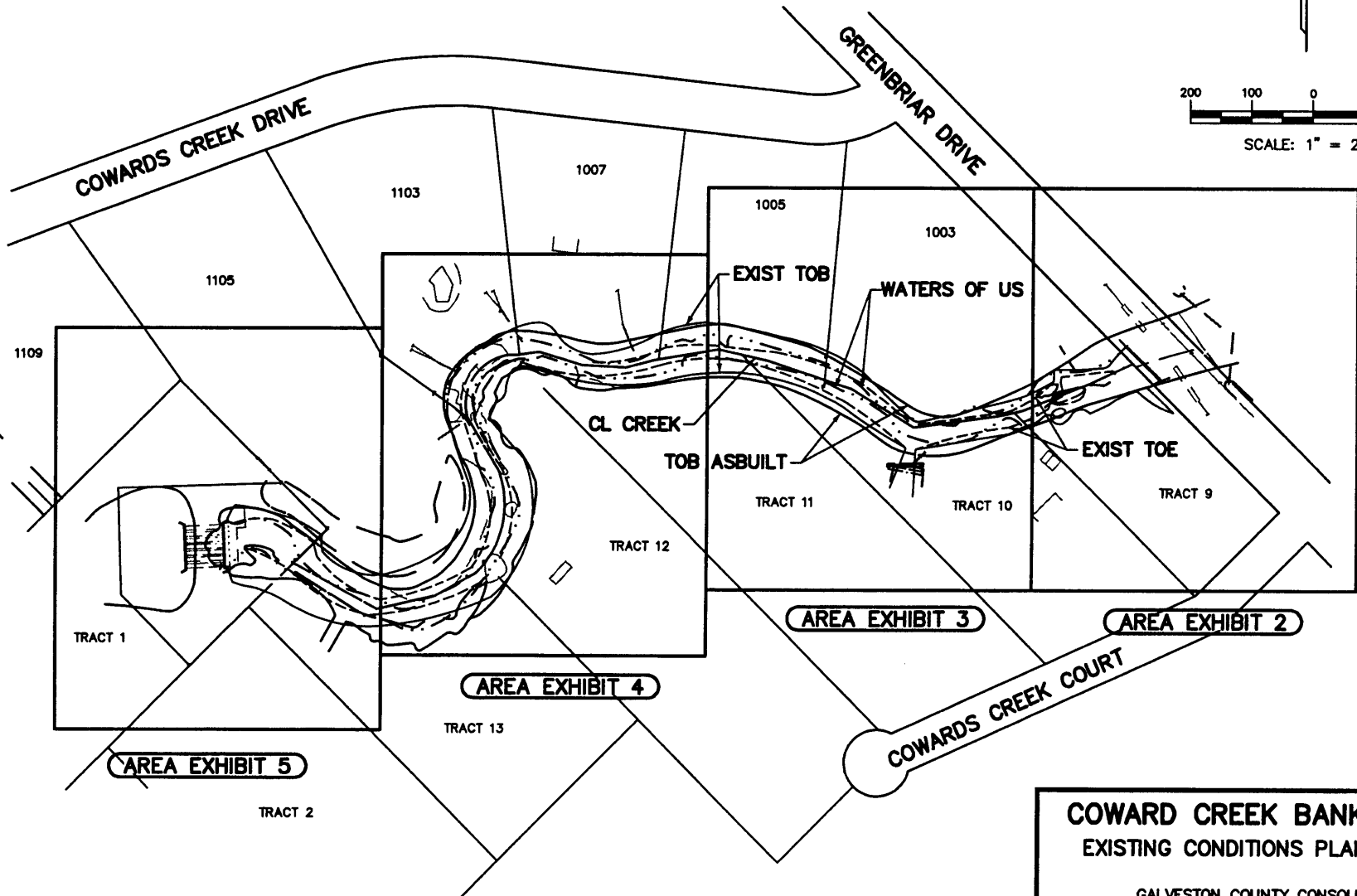
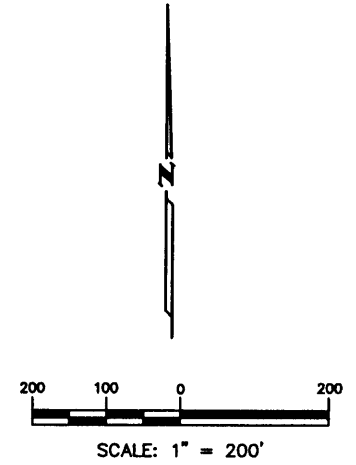
Figure 4

Background: Friendswood, TX,
7.5' USGS Quad Sheet (1982)

0 1000 2000 Feet

Map Produced May 19, 2004
Project #:7021-147

AFTER THE FACT



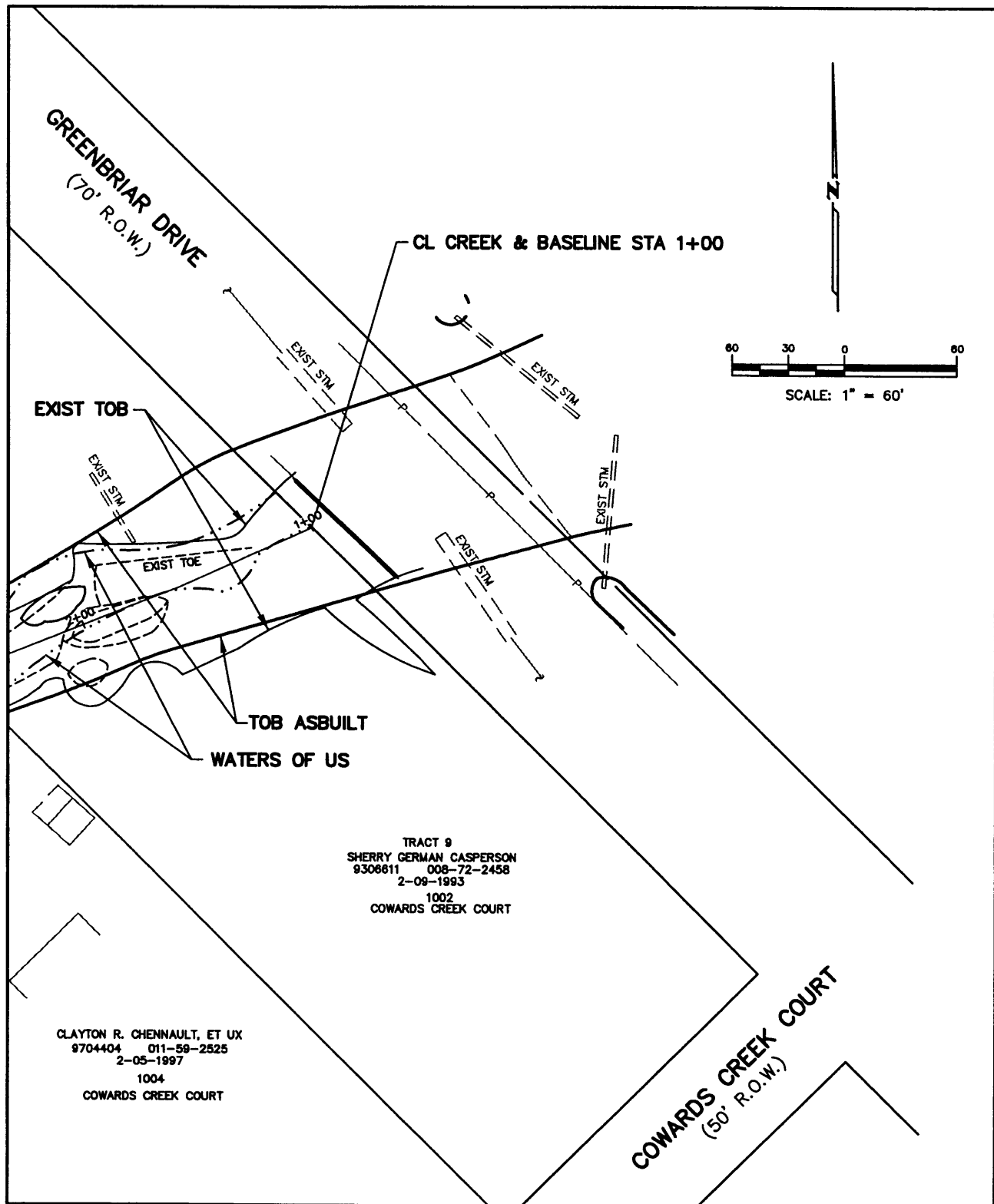
**COWARD CREEK BANK REPAIR
EXISTING CONDITIONS PLAN VIEW**

GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 2

SHEET 1

AFTER THE FACT



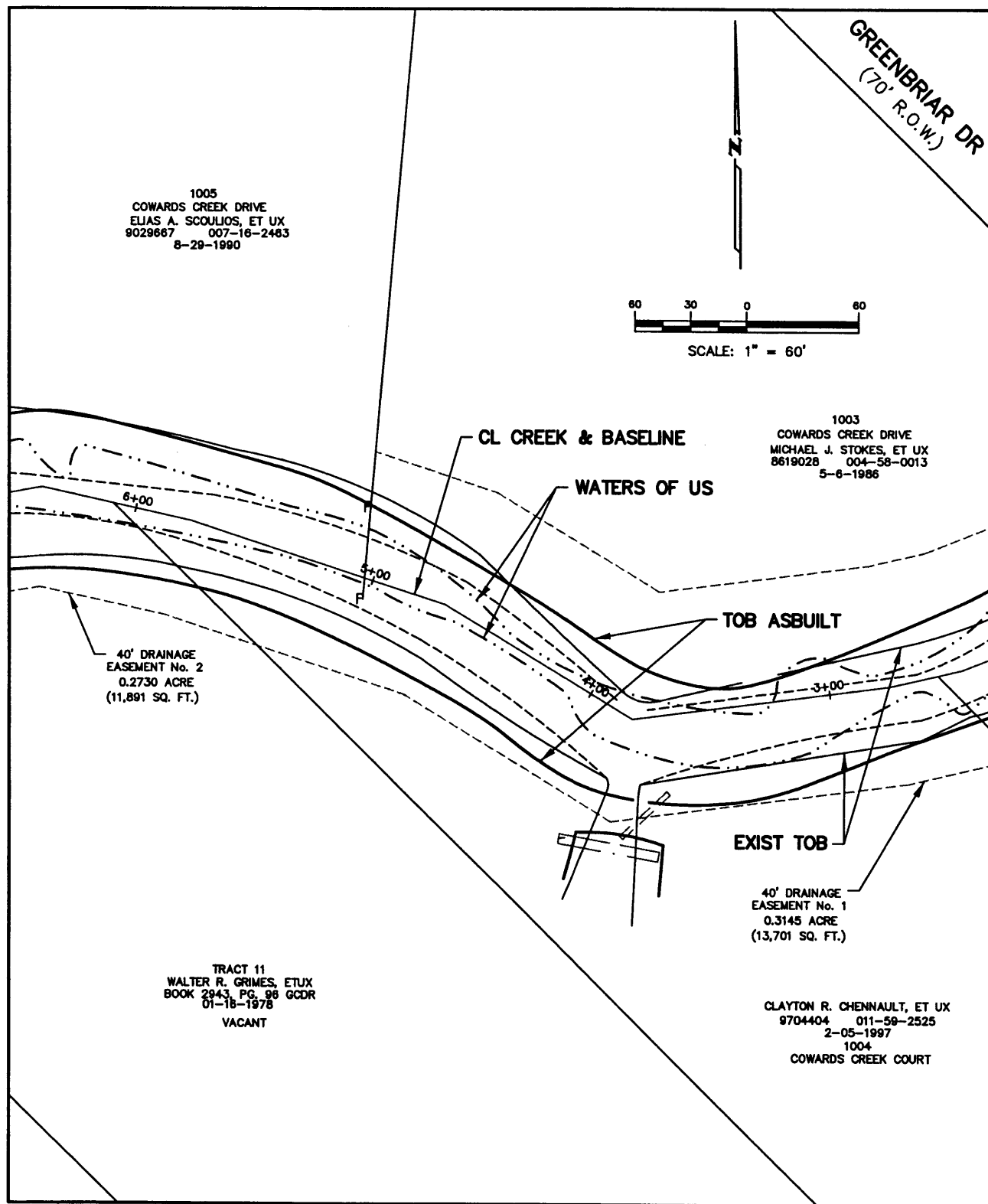
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**COWARD CREEK BANK REPAIR
EXISTING CONDITIONS PLAN VIEW**

GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 2

SHEET 2

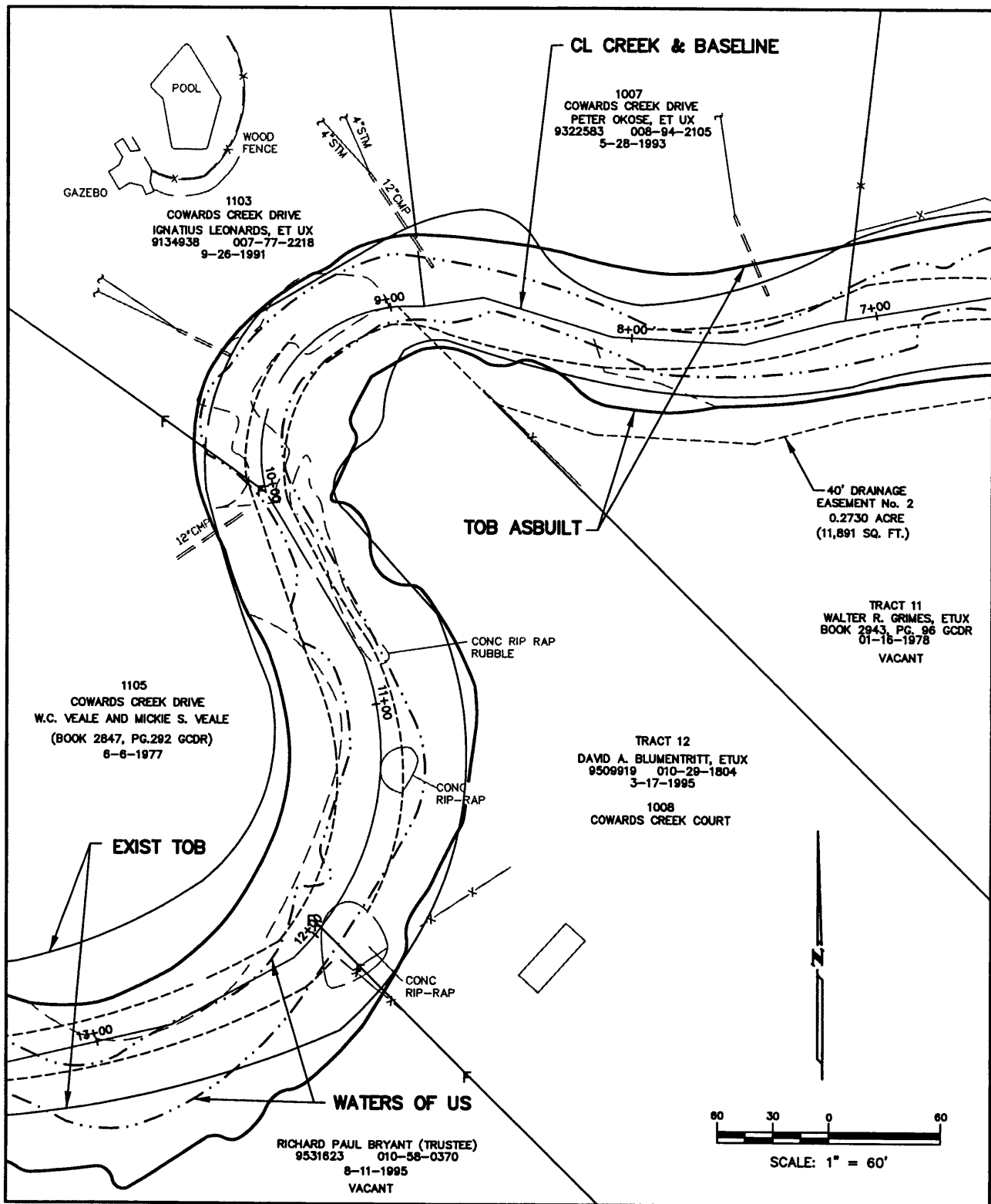


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**COWARD CREEK BANK REPAIR
EXISTING CONDITIONS PLAN VIEW**

GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 2



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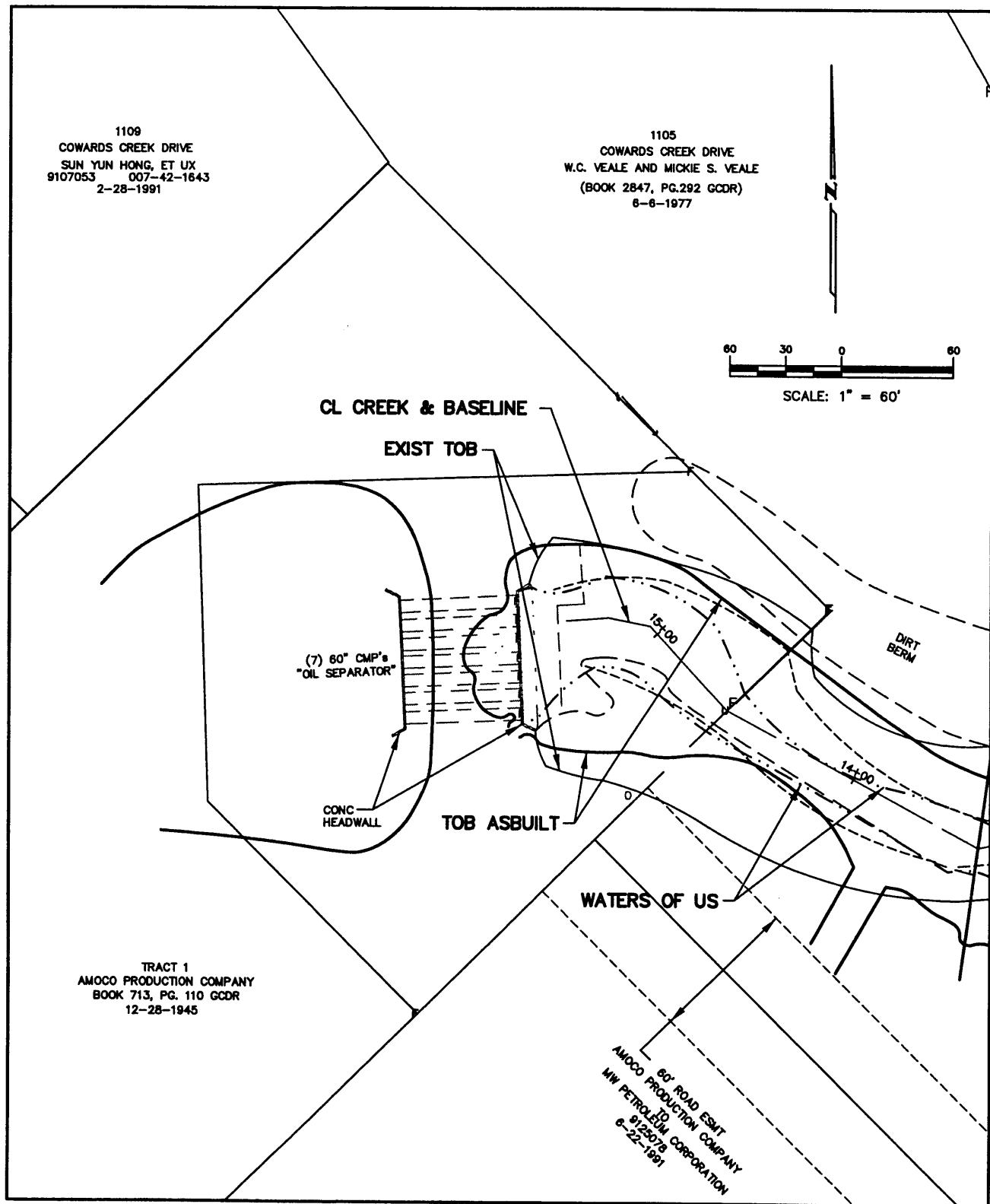
**COWARD CREEK BANK REPAIR
EXISTING CONDITIONS PLAN VIEW**

GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 2

SHEET 4

AFTER THE FACT



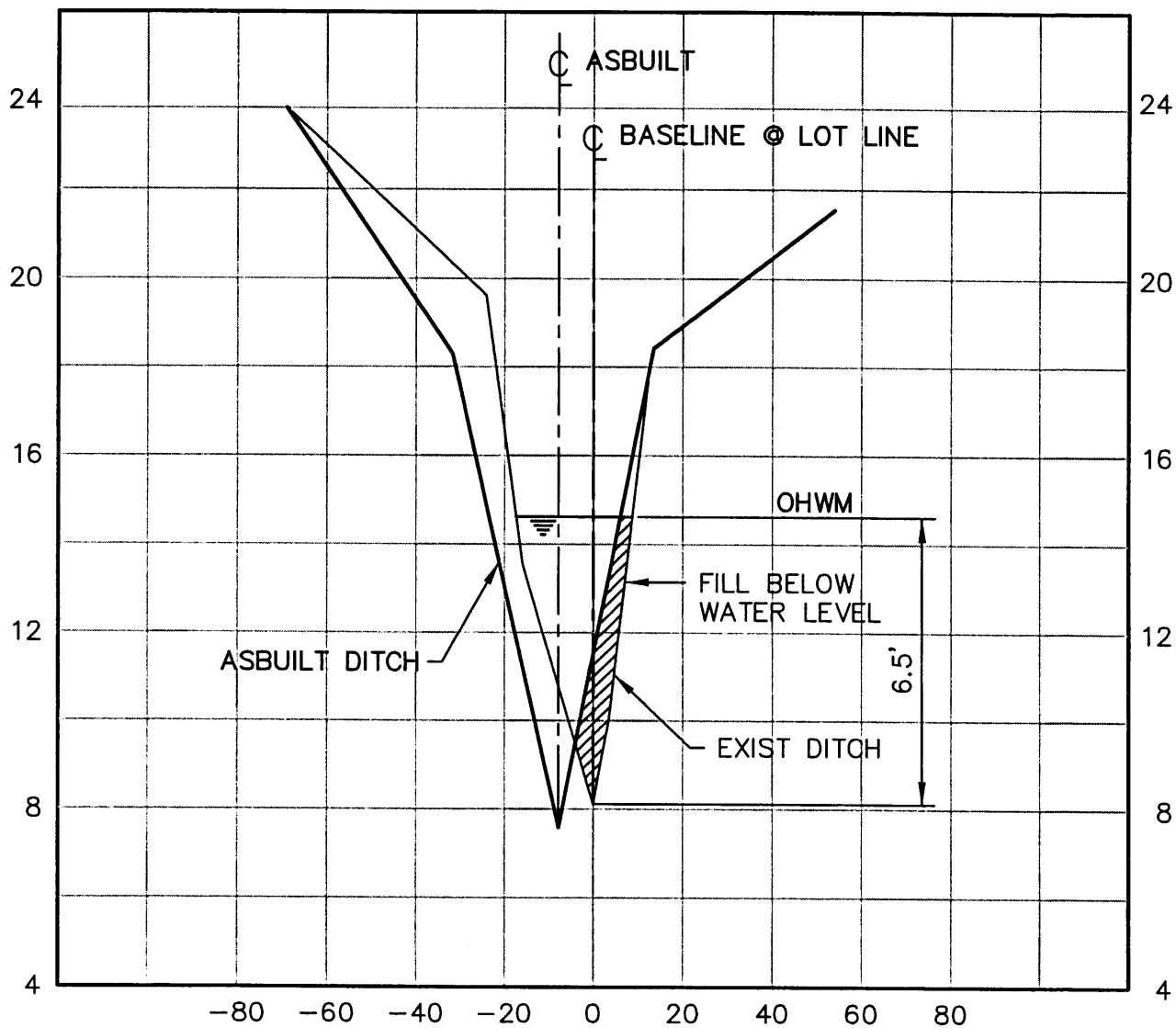
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**COWARD CREEK BANK REPAIR
EXISTING CONDITIONS PLAN VIEW**

GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 2

SHEET 5



STA 3+00

SCALE: H: 1"=40' V: 1"=4'

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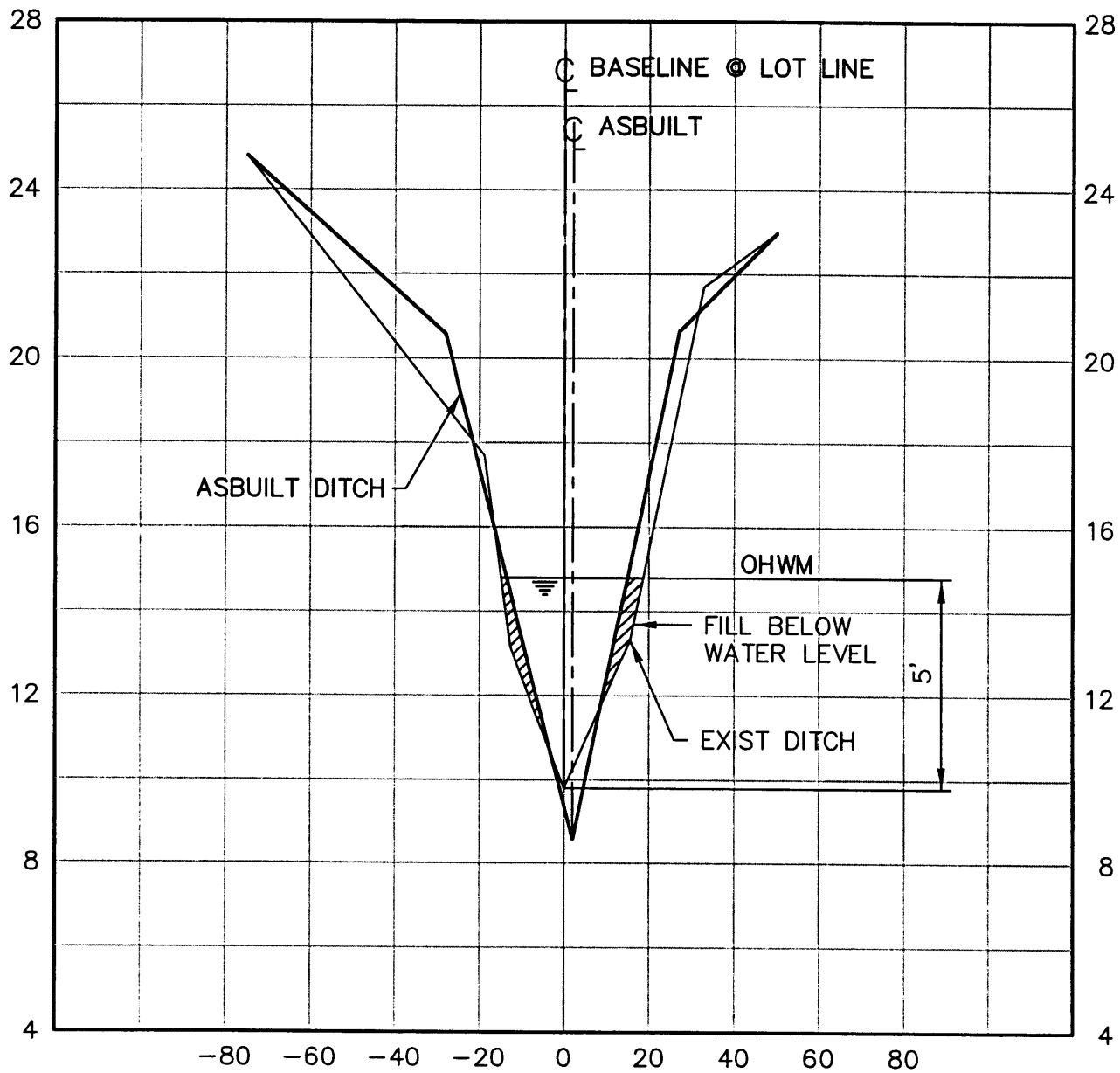
LEGEND

OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 3

SHEET 1



STA 5+00

SCALE: H: 1"=40' V: 1"=4'

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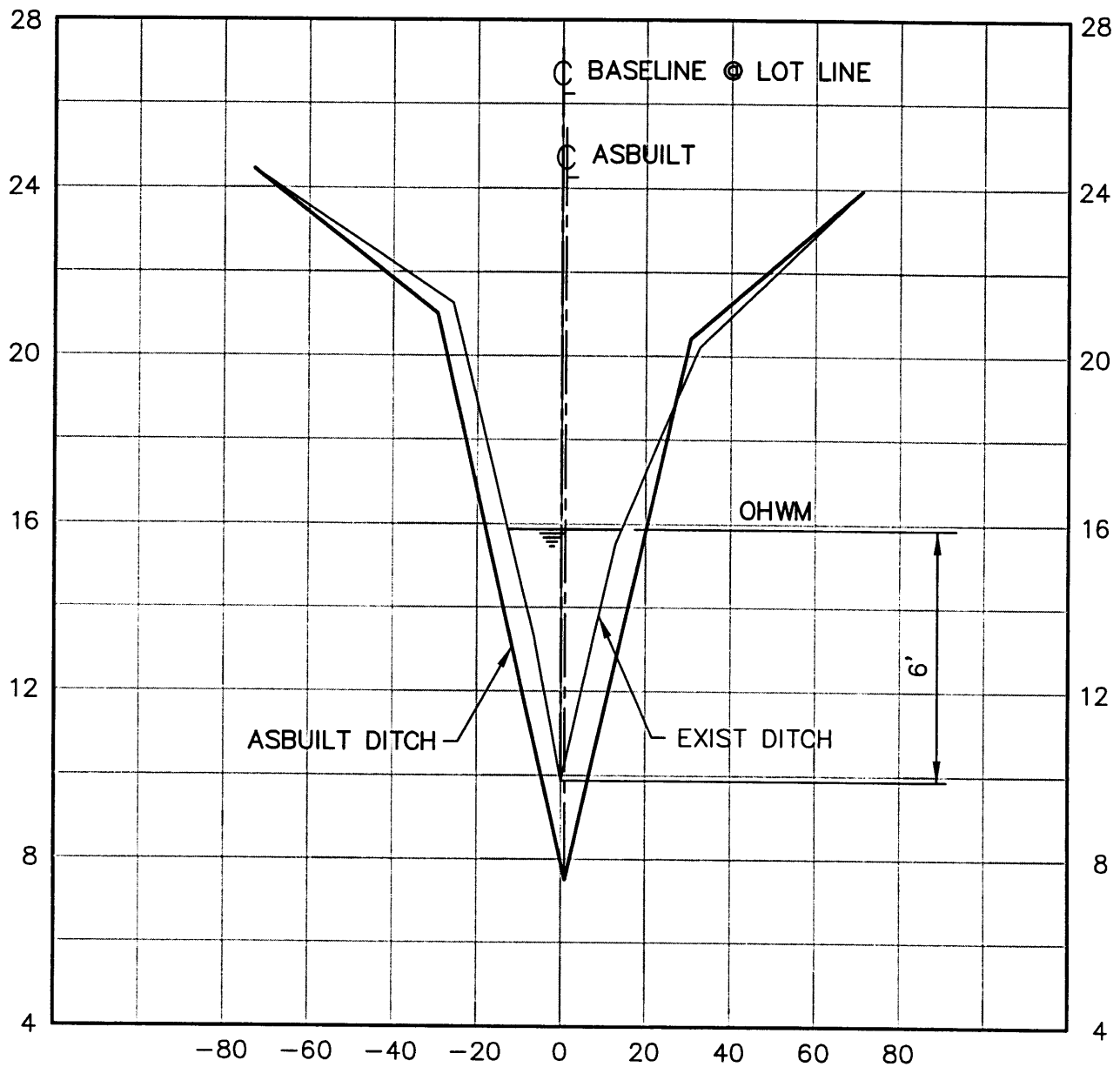
LEGEND

OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 3

SHEET 2



STA 7+00

SCALE: H: 1"=40' V: 1"=4'

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LEGEND

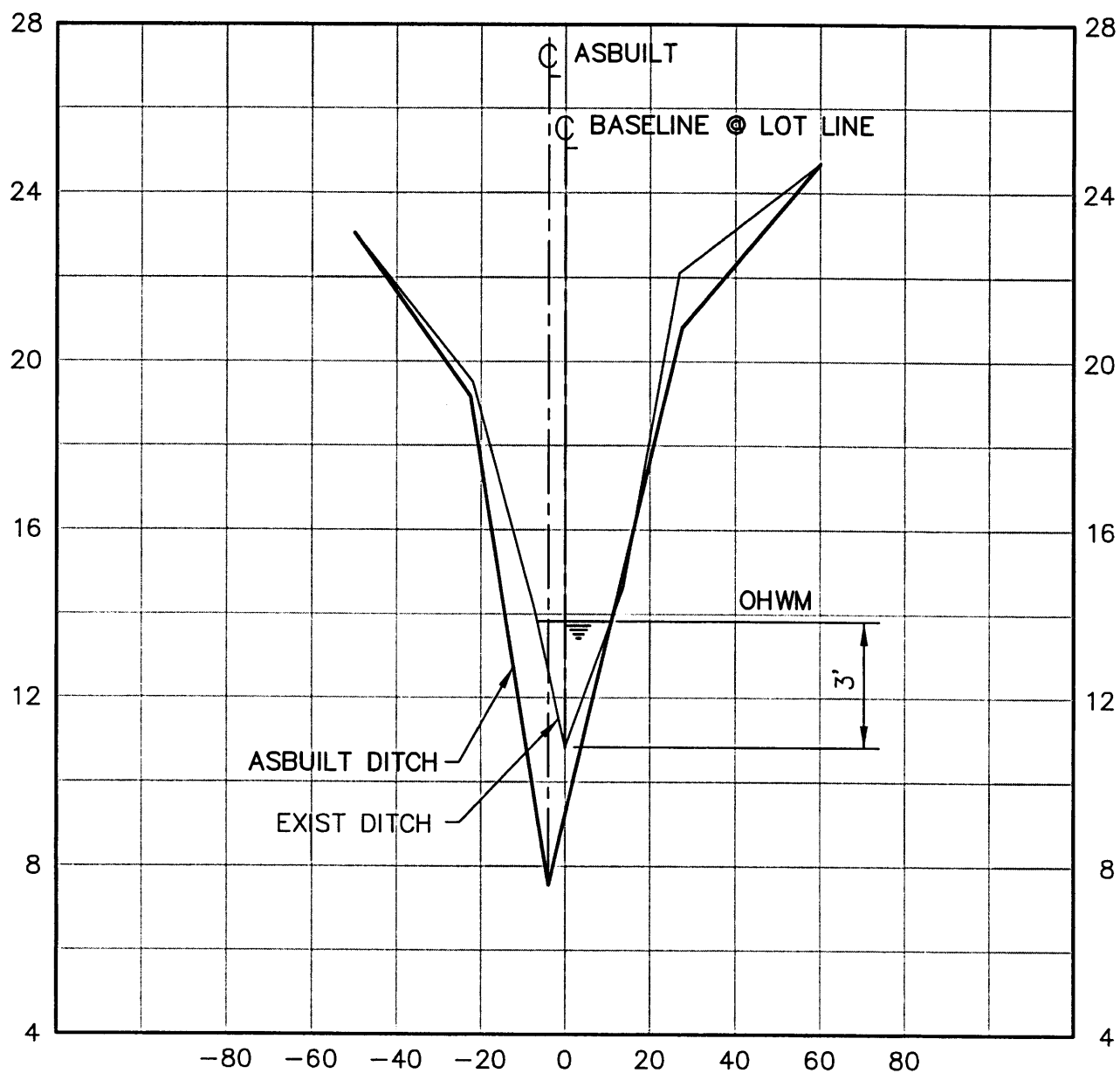
OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 3

SHEET 3

AFTER THE PROJECT

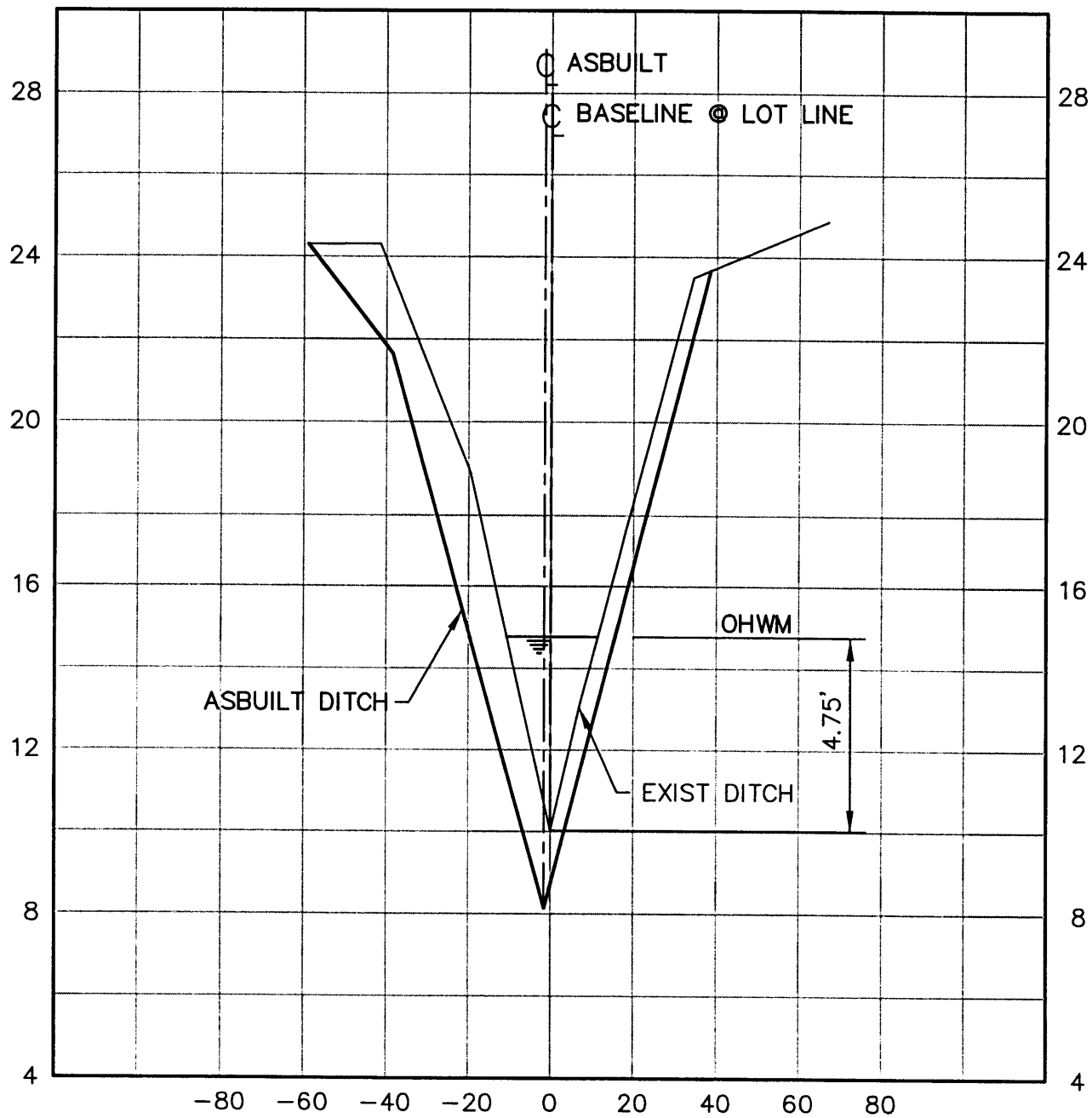


STA 9+00

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LEGEND
OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT



STA 11+00

SCALE: H: 1"=40' V: 1"=4'

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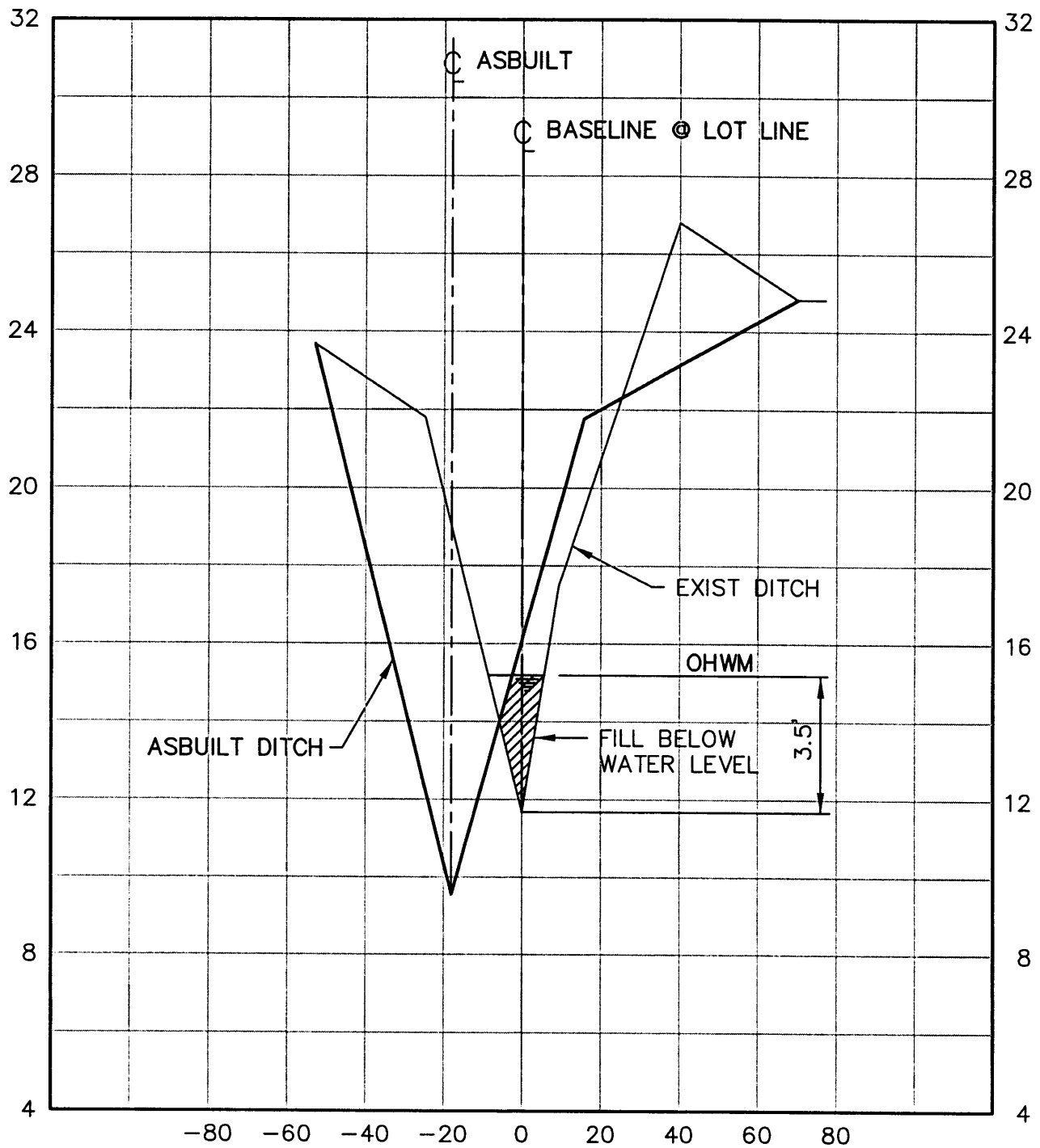
LEGEND

OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 3

SHEET 5



STA 13+00

SCALE: H: 1"=40' V: 1"=4'

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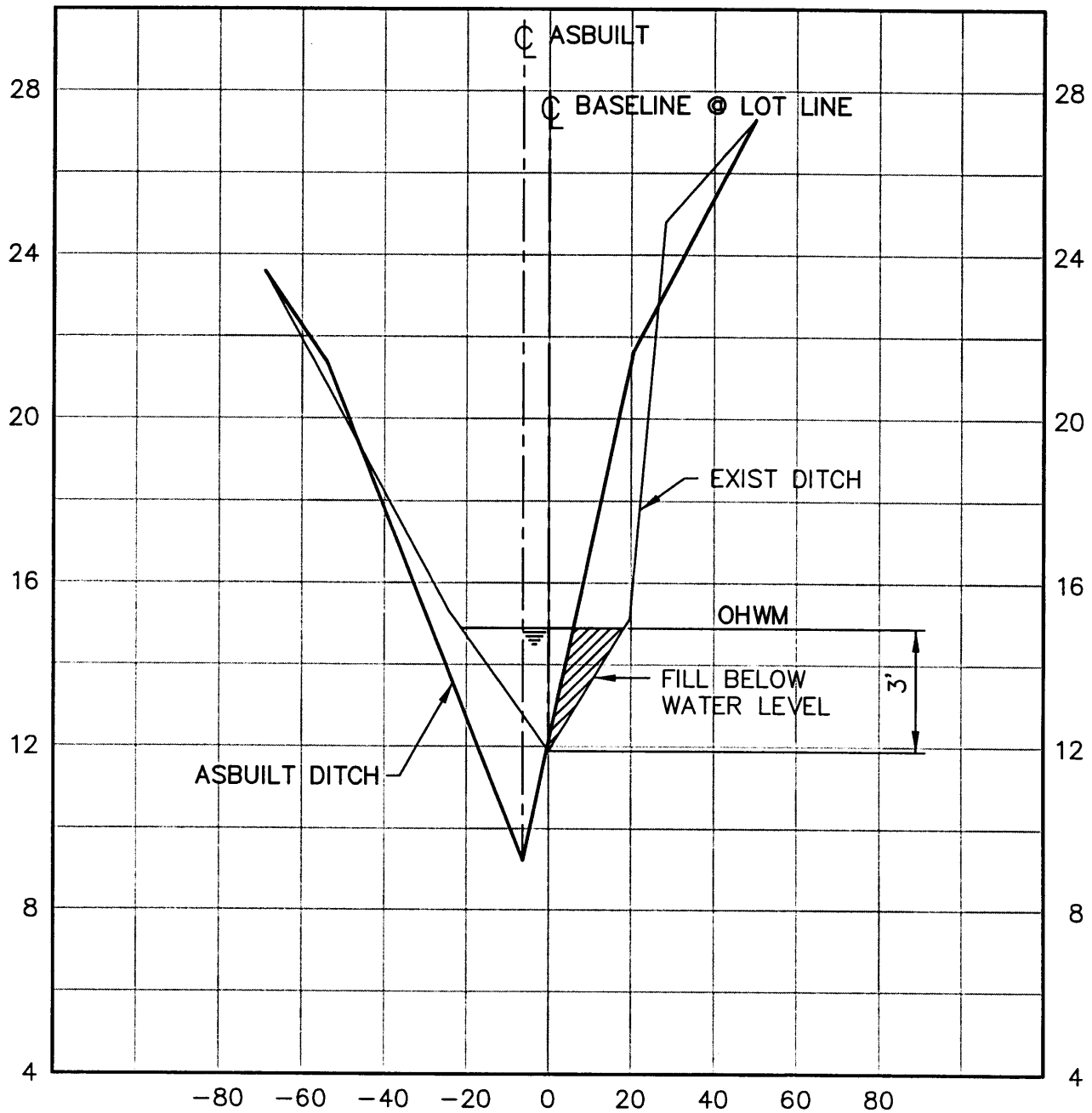
LEGEND

OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 3

SHEET 6



STA 15+00

SCALE: H: 1"=40' V: 1"=4'

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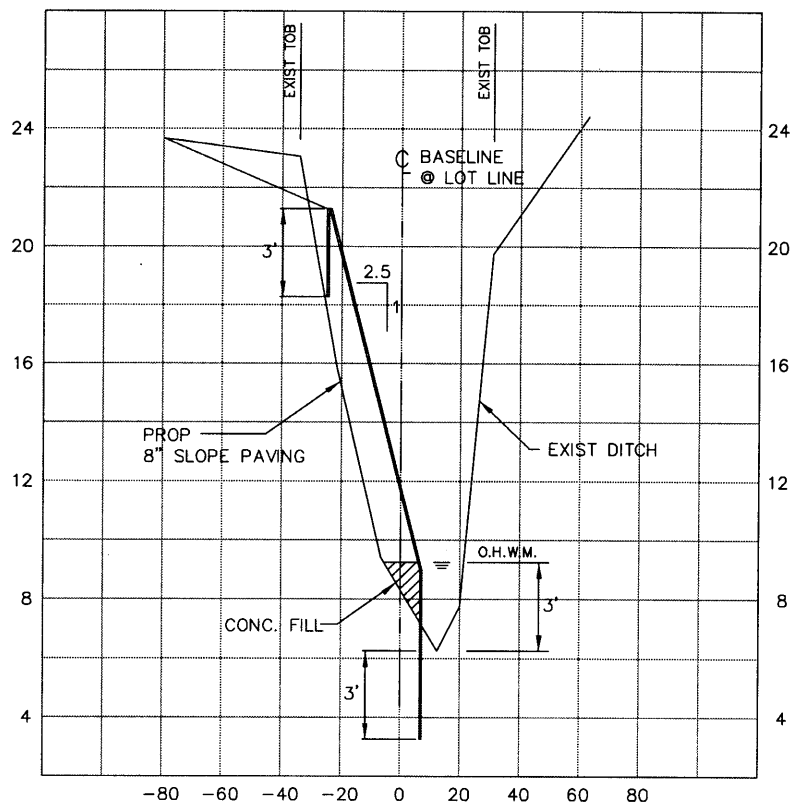
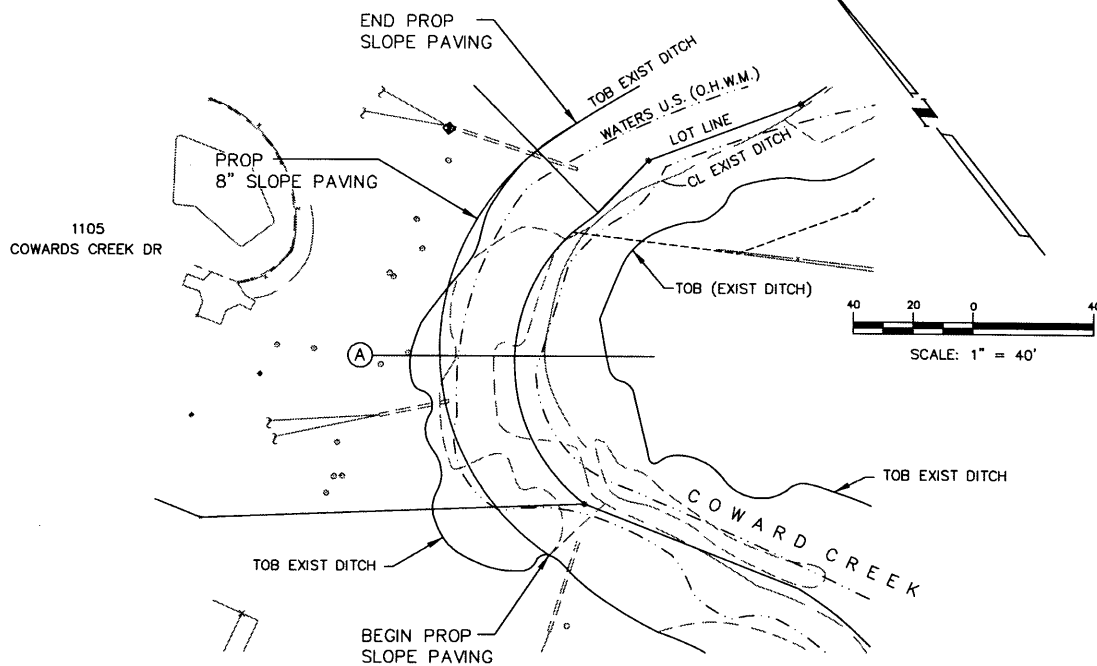
LEGEND

OHWM = ORDINARY HIGH WATER MARK

COWARD CREEK BANK REPAIR
EXISTING CONDITIONS
CROSS-SECTION VIEW
GALVESTON COUNTY CONSOLIDATED
DRAINAGE DISTRICT

FIGURE 3

SHEET 7



CROSS-SECTION 'A'
SCALE: H: 1"=40' V: 1"=4'

LEGEND

O.H.W.M. = ORDINARY HIGH WATER MARK

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REVISED PLAN DRAWING
COWARD CREEK BANK REPAIR
USACE CASE # 1-4621

**GALVESTON COUNTY CONSOLIDATED DRAINAGE DISTRICT
UNAUTHORIZED FILL IN COWARDS CREEK,
BETWEEN GREENBRIAR DRIVE AND AN EXISTING OIL SEPERATOR,
GALVESTON COUNTY, TEXAS**

MITIGATION AND MONITORING PLAN

September 2, 2004

The following document contains information relative to mitigation and monitoring for U.S. Army Corps of Engineers (USACE) Case Number I-4621.

ON-SITE MITIGATION

In order to provide on-site mitigation, Galveston County Consolidated Drainage District (GCCDD) proposes to install boulder clusters within the area of Cowards Creek impacted by the unauthorized fill. Boulder clusters are strategically placed, grouped or individual boulders along a channel bed. According to the Federal Interagency Stream Restoration Working Group's (FISRWG) *Stream Corridor Restoration Principles, Process, and Practices* manual (1998), boulder clusters are effective in most stream habitat types, including riffles, runs, flats, glides, and open pools. Therefore, selecting the location of these structures is flexible along the creek and can be based on accessibility by GCCDD. Furthermore, boulder clusters are not likely to wash away during high flow conditions (e.g. storm flows).

Ecological Purpose

Boulder clusters will benefit the stream ecology of Cowards Creek by:

- Establishing fish shelter and breeding areas,
- Creating cooler waters through shadowing, and
- Increasing water oxygenation through aeration.

Materials and Installation

Boulder clusters will be installed at three locations along the 1,500-foot segment that was impacted by unauthorized improvement activities. The proposed locations are depicted in Figure 1. The clusters will consist of irregularly shaped and angular boulders of approximately 3-foot diameter, and will be slightly embedded into the streambed to prevent movement downstream during high velocity conditions. Material removed in order to embed the boulders will be removed from the stream and disposed in an upland area. Incidental increases of turbidity occurring during installation will be of a minimal and temporary nature. Boulders will be placed in groups of three forming a triangular cluster, with spacing between boulders of approximately 6 inches to 1 foot. This configuration will provide in-stream cover and promote water oxygenation and scour pockets adjacent to the boulders when flow velocities exceed 2 cubic feet per second. A

typical plan view of in-stream boulder clusters is provided in *Water Related Best Management Practices (BMP's) in the Landscape* (CSD, 1999).

The FISRWG suggests spacing clusters within the same stream segment approximately one-third of the stream width apart (2001). GCCDD will install two clusters per location and ensure that the spacing conforms to the FISRWG recommendations.

OFF-SITE MITIGATION

GCCDD owns an approximately 16-acre property containing a potential riparian mitigation area in Galveston and Brazoria Counties (refer to enclosed **GCCDD Property Map**). GCCDD intends to construct a detention pond on this property at some point in the future. However, GCCDD proposes to design the pond and its associated outfall to Cowards Creek so as to minimize encroachment into the riparian area along Cowards Creek's south bank. The pond itself will stay outside the riparian area, with only an outfall structure (50 foot wide or less) extending perpendicularly through the riparian area to Cowards Creek. The pond and outfall have not yet been designed; therefore, the final location of the outfall structure cannot be determined at this time.

In order to provide additional mitigation for the previous impacts to Cowards Creek (**0.34 acre**), GCCDD proposes to restore and enhance the approximately 100-foot wide riparian area along the south creek bank for a distance of approximately 1,300 linear feet between Baker Road and Hackney Road, totaling approximately **3.4 acres**. In addition, GCCDD proposes to preserve the riparian area in perpetuity, excluding the 50 feet necessary for the future detention pond outfall structure. The proposed riparian mitigation area is shown between the dashed blue and solid yellow lines on **GCCDD Property Map**.

An SWCA biologist recently visited the site to document the physical and biological conditions of the site and evaluate potential for mitigation measures. **Attachment A** provides photographs of the mitigation site. The riparian area along the south bank of Cowards Creek at this location is wooded with large mature trees, immature trees, and a scrub-shrub understory. The existing site tree canopy cover was estimated to be >75%, except in the area occupied by a landscape easement adjacent to Baker Road. In this area the canopy cover was estimated to be 25%.

Tree and shrub species observed onsite included sugarberry (*Celtis laevigata*), ash (*Fraxinus* spp.), gardenia (*Gardenia* spp.), yaupon (*Ilex vomitoria*), privet (*Ligustrum sinense*), loblolly pine (*Pinus taeda*), willow oak (*Quercus phellos*), post oak (*Quercus stellata*), live oak (*Quercus virginiana*), Chinese tallow (*Sapium sebiferum*), and elm (*Ulmus* spp.). Typical vines and herbaceous vegetation observed on site included ragweed (*Ambrosia* spp.), woodoats (*Chasmanthium* spp.), honeysuckle (*Lonicera japonica*), sensitive Briar (*Mimosa quadrivalvis*), greenbrar (*Smilax* spp.), and St. Augustine grass (*Stenotaphrum secundatum*).

Restoration and Enhancement

The riparian area has a moderate amount of the invasive, non-native Chinese tallow and Chinese privet. GCCDD proposes to restore the riparian area to a higher-quality environment by implementing chemical and mechanical control measures for these two species.

To kill the existing large tallow trees, GCCDD will apply a commercially available chemical herbicide (e.g. Garlon) to individual plants. Large tallow trees will be notched prior to applying the herbicide into the notch for a more effective application. The application will occur during late summer or early fall following seed set to ensure that optimum amounts of herbicide are translocated to the root system of the tree. GCCDD will monitor the progress of the herbicide and mechanically remove each tree when it has died.

Large stands of Chinese privet will be controlled by mechanically cutting the stems to the ground and painting the cut stumps with an herbicide effective for this method (e.g. imazapyr or glyphosate/X-45).

Occasional mowing of the affected areas throughout the growing season will mechanically control sprouting of tallow and privet. GCCDD will avoid mowing immediately adjacent to the banks of Cowards Creek and will hand-pull/cut and chemically control tallow or privet growth in this area. GCCDD will dispose of all vegetation offsite in an appropriate manner (i.e. burning or sanitary landfill) to avoid reseeding of the site.

In addition to invasive species control, GCCDD will enhance the area by planting additional native trees in the mitigation area. For each Chinese tallow tree removed with a diameter breast height (dbh) greater than 5 inches, GCCDD will plant a bottomland hardwood sapling within the mitigation site. The specific locations of planted trees will be at the discretion of a qualified biologist at the time of planting, and will be based on types of native species selected. Preference will be given to less wooded areas near Baker Road due to the low canopy cover there. The tree species will be selected from deciduous hardwoods native to riparian areas in Galveston and Brazoria County, and based on commercial availability at the time of planting.

Preservation

GCCDD proposes to preserve the riparian area as a natural riparian greenspace in perpetuity via a conservation easement or similar instrument. In addition, GCCDD plans to allow the public access to the area in order to enjoy one of the few remaining wooded natural areas along Cowards Creek. GCCDD will not cut or clear any native trees on the mitigation site, other than the minimum necessary for the detention pond outlet, unless they pose a hazard to the visiting public or become diseased.

MONITORING AND MAINTENANCE

On-Site

GCCDD proposes to conduct site visits to the on-site mitigation locations at three months, 1 year, and 2 years (3 total visits) following installation to confirm boulder stability (i.e. that the boulders do not move significantly due to high water velocities or create instability to the adjacent streambanks). GCCDD will submit a brief letter report and photographs documenting the stability of each location after each visit.

Per the USACE technical note *ERDC TN-EMRRP-SR-11*, boulders that have dislodged and moved a few feet will not be replaced unless they are causing bank stability problems (e.g. erosion) (2000). Significant movement downstream (>10 feet) or bank erosion caused by the hydraulic impacts of the boulders will be reported to USACE. Should this occur, USACE and GCCDD will evaluate moving the boulder(s) to a section of the stream with a lower velocity.

Off-Site

GCCDD proposes to evaluate the off-site mitigation location one month after herbicidal applications, and then at three months, six months, 1 year, and 2 years (5 total visits) following the initial invasive species control measures to evaluate their success. Should there be any regrowth of Chinese tallow or privet, GCCDD will take corrective measures to control the target species that survived the initial control effort. These corrective measures will include reapplication of chemical and mechanical controls. GCCDD will submit a brief letter report and photographs documenting the restoration/enhancement and site conditions after the 1-year and 2-year visits (two total reports).

Because the site is currently wooded with large mature hardwoods and because trees planted at the site will be a direct replacement of an invasive species, GCCDD does not propose long term monitoring of the planted trees. However, in the interest of protecting GCCDD's investment in trees and the public enjoyment of the site, GCCDD will undertake reasonable maintenance measures (e.g. watering as needed) to ensure the viability of the planted trees.

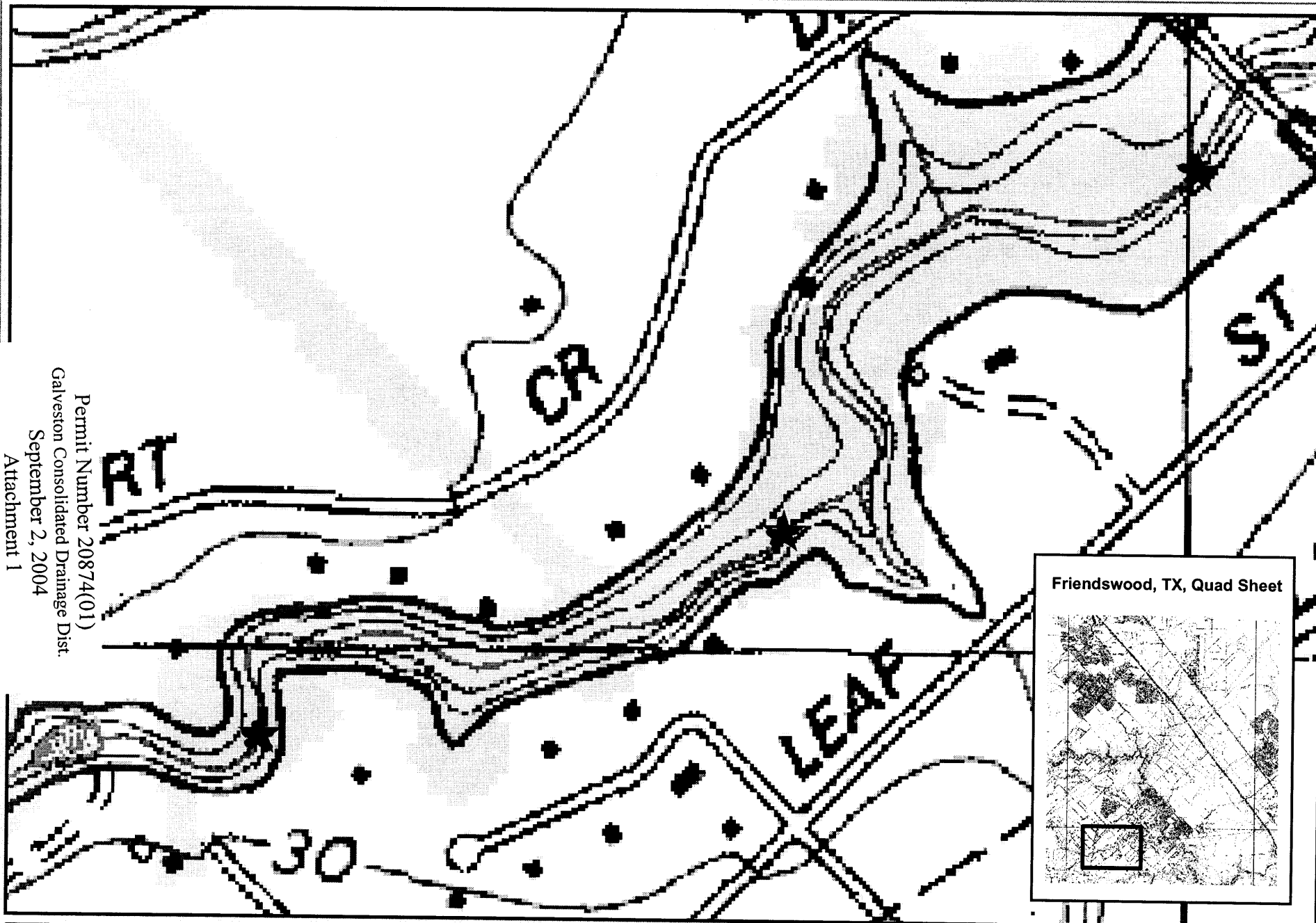
On behalf of GCCDD, SWCA[®] Environmental Consultants (SWCA) respectfully submits this mitigation plan for review. If you have any questions or comments regarding this plan, please contact Catherine Mayhew at (713) 934-9900.

REFERENCE DOCUMENTS

Center for Sustainable Design (CSD), Mississippi State University. "Boulder Clusters." *Water Related Best Management Practices (BMP's) in the Landscape*. 1999. <http://www.abe.msstate.edu/Tools/csd/NRCS-BMPs/pdf/streams/habitat/boulderclusters.pdf> (18 June 2004)

FIRSWG. 10/1998, revised 2001. *Stream Corridor Restoration: Principles, Processes, and Practices*. By the Federal Interagency Stream Restoration Working Group (FIRSWG) (15 Federal agencies of the US gov't). GPO Item No. 0120-A; SuDocs No. A 57.6/2:EN3/PT.653. ISBN-0-934213-59-3.

USACE. 2000. ERDC TN-EMRRP-SR-11. *Boulder Clusters*.
<http://www.wes.army.mil/el/emrrp/pdf/sr11.pdf> (22 June 2004)



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Attachment 1
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SWCA
ENVIRONMENTAL CONSULTANTS

Cowart Creek Project Site
Galveston County, Texas

Figure 1

★ Boulder Cluster

Background: Friendswood, TX, 7.5'
USGS Quad Sheet (1982)

0 150 300 Feet

Map Produced June 23, 2004
Project # 7021-147



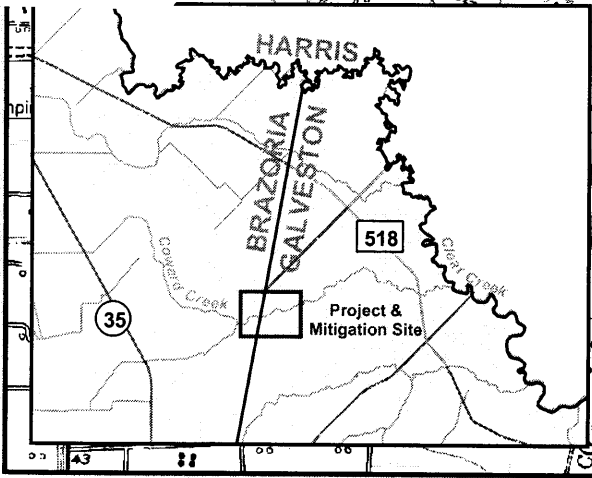
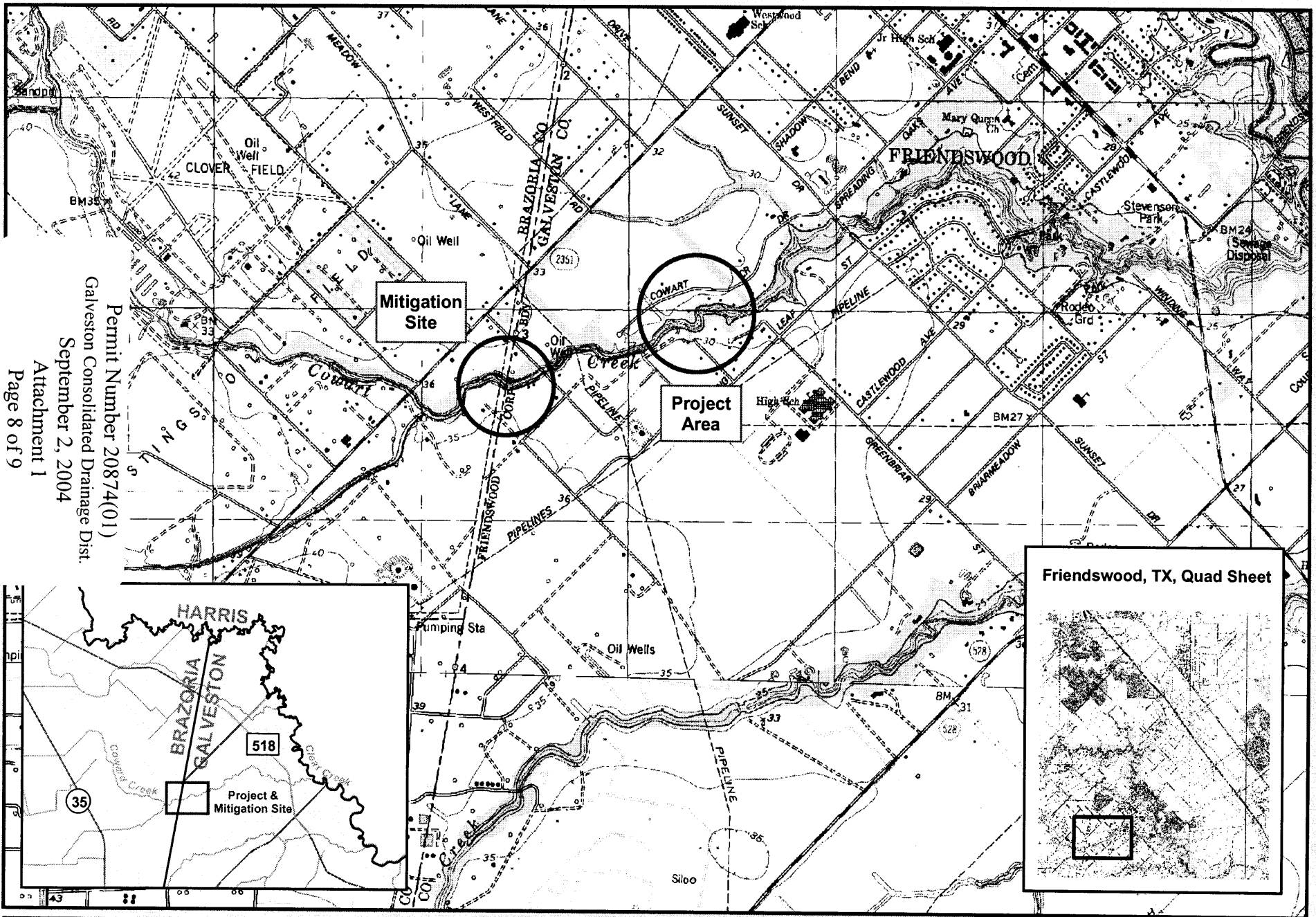
BOULDER CLUSTERS

Additional Drawings:

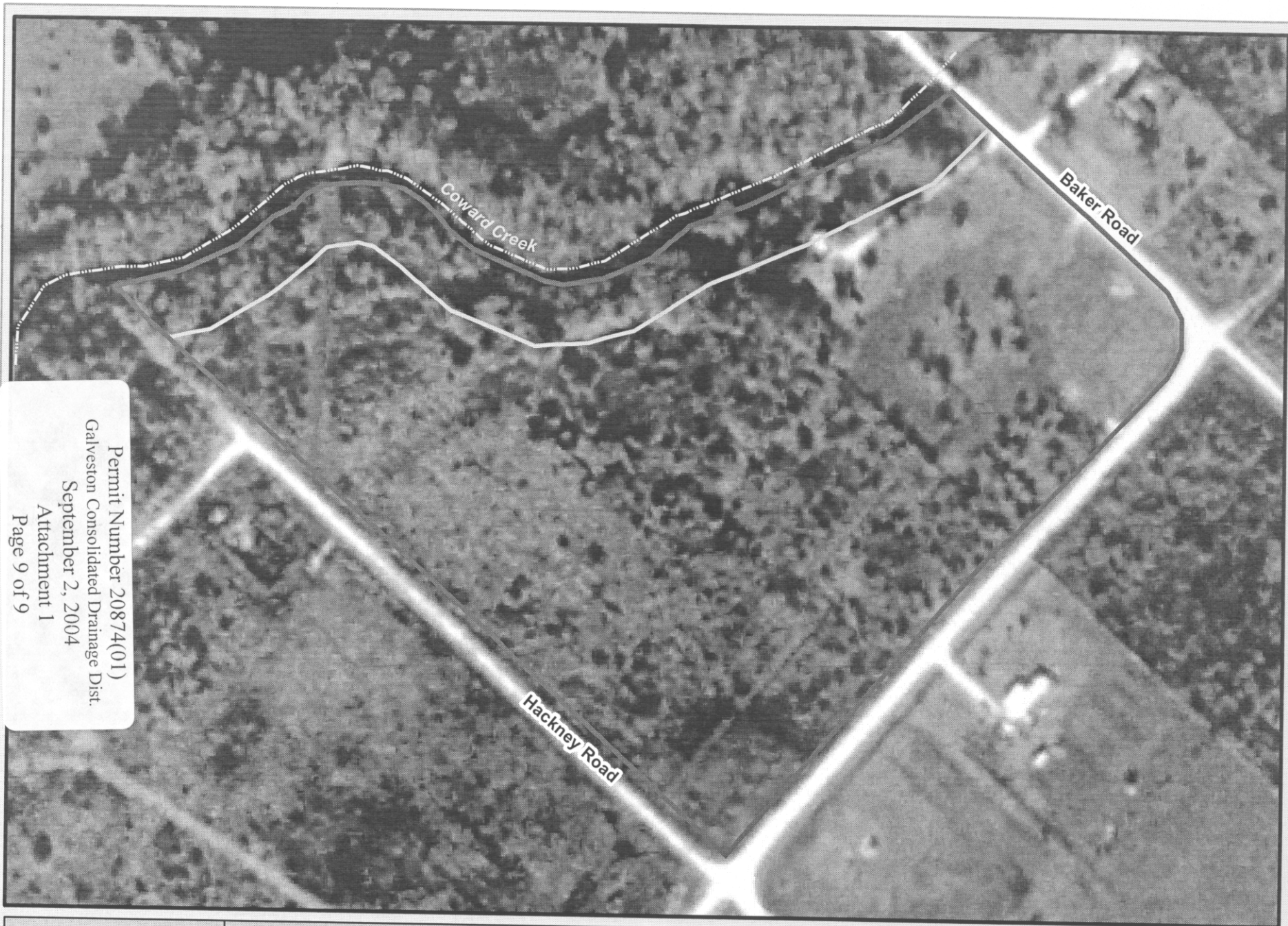


**Boulder Clusters
Plan View**

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Attachment 1
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

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ENVIRONMENTAL CONSULTANTS

**Coward Creek Mitigation Area
GCCDD Property**
Brazoria & Galveston Counties, TX

 Property Boundary
 100' Buffer

Background: Friendswood, TX DOQQ
(1995)
0 85 170 Feet
Map Produced August 26, 2004
Project #: 7021-0001